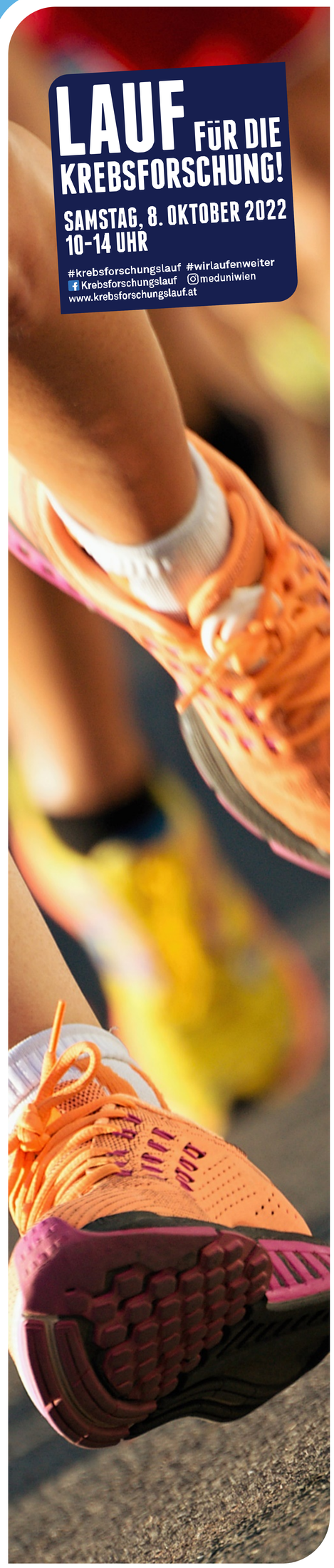

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Individualized breast cancer MRI screening in high-risk women enabled by machine learning

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Summary

The project aims at enhancing MRI breast cancer (BC) screening with help of machine learning, to improve the outcome for women at high-risk of developing BC. We will develop and validate machine learning techniques for personalized screening, early detection of breast cancer, and a reduction of false positives leading to unnecessary biopsies.

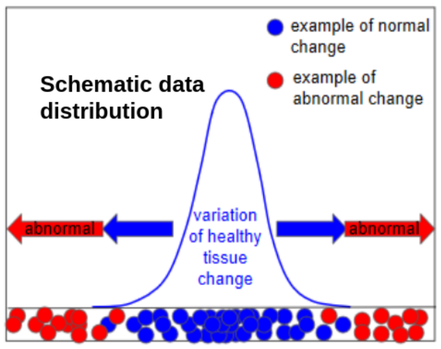
Objectives

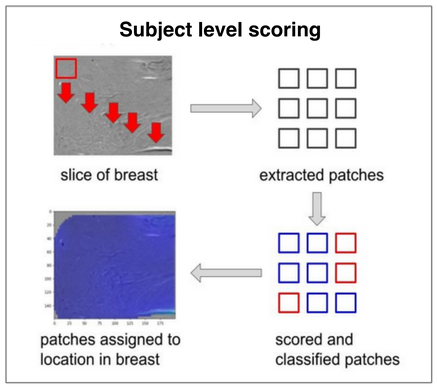
1. Develop machine learning methods for the prediction of breast cancer emergence from early imaging precursor signatures, forming cancer risk maps that take overall structure and local appearance anomalies in MRI into account.
2. Enable individualized screening in high-risk women based on prediction models using breast MRI together with comprehensive clinical, genetic, and mortality data, for personalising screening intervals.
3. Develop machine learning methods to improve the classification accuracy of lesions in breast MRI to reduce false positives, and avoide unnecessary biopsies.

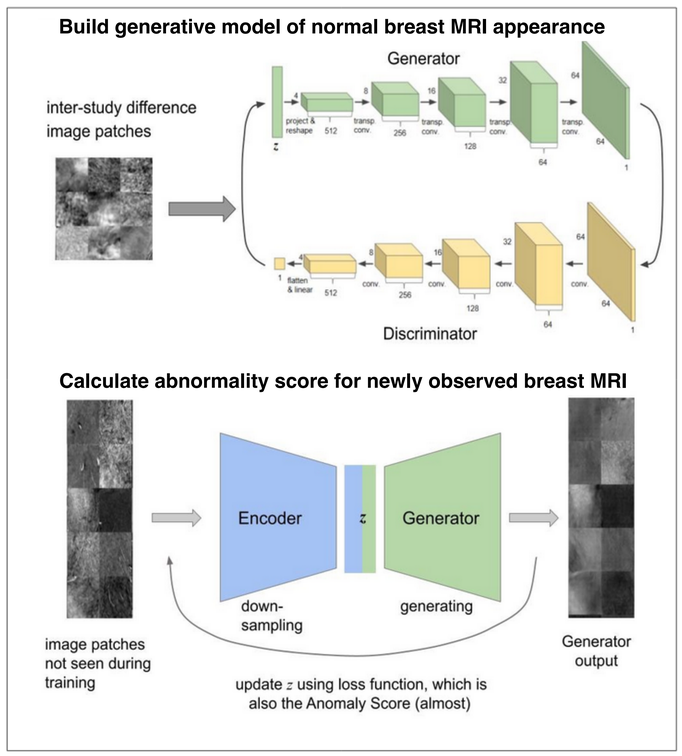
Early signatures of cancer

We will develop models for the robust detection of early image signatures of cancer, taking local, and vicinity characteristics into account. Going beyond the established paradigm of training supervised models to detect known lesions, we will train anomaly detection models. They exploit the data inbalance of a screening cohort more effectively, and represent normal variability.

We will test if lesion detection can be improved by generative adversarial network models (GAN) capturing a wider range of natural tissue imaging variability from individuals for robust and accurate lesion detection in MR data. It will expand the range of detectable patterns that can be linked with individual risk of future disease onset, as it will identify precursor forms of lesions.







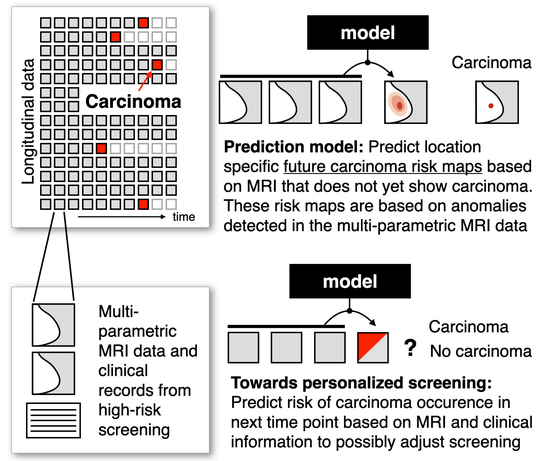
A Generative Adversarial Network model is trained to capture normal appearance variability of breast tissue in MRI. The model can then process newly observed breast MRI data with a corresponding model approximation to detect anomalies. These anomalies are candidates for image signatures that predict future emergence of cancer.

Personalized Screening

Deep learning learning models can exploit both imaging data and categorical and scalar lab measurements to perform prediction based on the joint input data. These models should enable the steering of screening and interventions with multi-modal risk profiles.

We plan to investigate logistic regression models based on traditional risk factors, such mutation status, FGT, BPE, number of biopsies, age, and family history and personal history of BC, and compare these factors to DL model-based risk.

To evaluate the novel approaches, we will compare our models against conventionally used Breast Cancer Risk Assessment models. This will serve as a basis for adapting screening intervals based on individual risk profiles enhanced by image information.



Predicting location specific risk of lesion emergence from longitudinal breast MRI imaging data.

Summary

The project is an interdisciplinary effort in the areas of machine learning, imaging, pathology, cancer prevention, and care. It aims at identifying novel imaging signatures that predict future emergence of lesions. Individual risk profiles taking imaging signatures into account, may be an effective means to enable personalized adaptation of screening protocols in women at high risk of developing breast cancer.

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